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Two New Species of Polydesmid Millipeds from Limestone Caves in Tokushima Prefecture, Japan*

With 3 Text-figures

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(*Communicated by* M. UÉNO)

ABSTRACT In the present paper two new species of the genus *Epanerchodus* are described from three limestone caves in Tokushima Prefecture: *Epanerchodus kiuchii* n. sp. and *E. biaduncus* n. sp. The diagnostic features of these species are found in the shape of the body segments and the male gonopods. It is interesting that the new millipeds show a close resemblance to the members of the genus known in the eastern parts of Japan, particularly to those inhabiting certain caves in the Tôkai district.

So far as is known to the author, about a dozen limestone caves have hitherto been found in Tokushima Prefecture in the eastern parts of the Island of Shikoku. Most of these caves were biologically investigated by Dr. Shun-Ichi Uéno and Mr. Jujiro Ishikawa more than ten years ago. According to the former zoologist, a number of specimens of troglobiontic millipeds were obtained at that time, but none of them have been satisfactorily studied up to the present.

Recently, more extensive cave surveys have been carried on in the same area by Dr. Uéno, Mr. Kiuchi and Mr. Yoshida, who have accumulated new specimens of cave-dwelling millipeds and submitted them to the present author's study. Their collections contain several troglobiontic species of the genus *Epanerchodus*, all of which seem to be new to science. In the present paper, two of these new species, which will be described under the names *E. kiuchii* and *E. biaduncus*, show a close resemblance to forms which occur in certain caves of the Tôkai district. It is difficult to decide at present whether or not such a morphological similarity indicates a true affinity, but the fact is certainly interesting, particularly since a similar pattern of distribution is already known in some other groups of cavernicoles (according to Dr. Uéno, personal communication).

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Epanerchodus kiuchii n. sp.
(Japanese name: Kiuchi Obiyasude)

Diagnosis: A medium-sized, pigment-less cavernicole related to *E. sulcatus* Miyosi (1954, p. 289, fig. 2) in the form of body segments; distinguished from the latter species by its smaller size and by the shape of the gonopods.

Male holotype: Color muddy white. Length about 19 mm, greatest width 3.4 mm. Head small, body broad, lateral keels very thin, antennae and legs slender; the shape of head and of some selected segments as shown in text-figures; widths of them as follows:

Head =1.8 mm   Collum=1.7 mm   Seg. 2=2.4 mm
Seg. 3=2.6 mm   Seg. 4=2.9 mm   Seg. 5=3.1 mm
Seg. 6=3.2 mm   Seg. 10=3.4 mm   Seg. 14=3.4 mm
Seg. 16=3.2 mm   Seg. 18=2.4 mm.

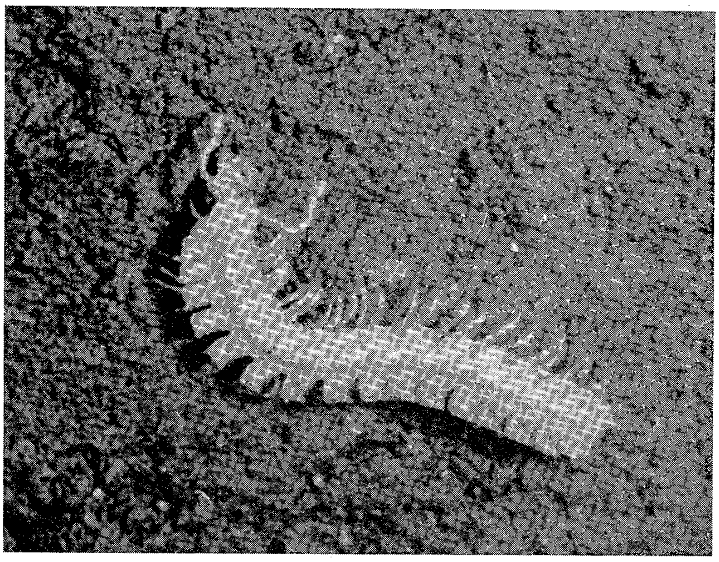

Fig. 1. A mature specimen of *Epanerchodus kiuchii* n. sp. crawling on the soil surface in Himise-dô Cave. (Photo by M. Kiuchi, 23 July 1967)

Head sparsely covered with short hairs. Antennae slender, approximately 4.5 mm long, reaching back to segment 5; the ratio in length of joints 5 through 7 and in their width (in parentheses) is 24(7):17(9):9(7); sensory groups on these joints well developed. Collum elliptical, nearly as wide as head, anterior margin more broadly rounded than the posterior; two rows of fine bristles present along the anterior margin and on the central area; lateral notches absent. Second segment broader than collum, with a weak, transverse median impression; lateral keels flat, slightly reflexed and bent forward. Succeeding segments, each with sculpture of the same general pattern on the posterior half of dorsum as shown in text-figure 2, A–D.

Lateral keels markedly developed, thin, nearly horizontal, and wider than long (length/width ratios of segments 2–4, 7 and 10 are 1:1.9, 1:1.8, 1:1.7, 1:1.5 and 1:1.4 respectively). Anterior margin of typical keels nearly straight, bordered by a ridge, of which the surface is smooth. Lateral margin straight or slightly convex with 3–4 weak notches. Posterior corners rectangular in anterior segments, becoming slightly tooth-like on segments 9–15, and acutely produced on posterior ones. Pores open on the strongly depressed lateral margin near the fourth notch of pore-bearing keels. Legs slender, without spherical bristles. Sternites quadrate, with a deep crossing furrow, and pubescent; posterior corners not produced.

Gonopods rather small; *in situ*, their telopodites in contact with each other, and tibiotarsi semicircularly curved in ventral view (Fig. 2, G). Femoral clivus prominent,

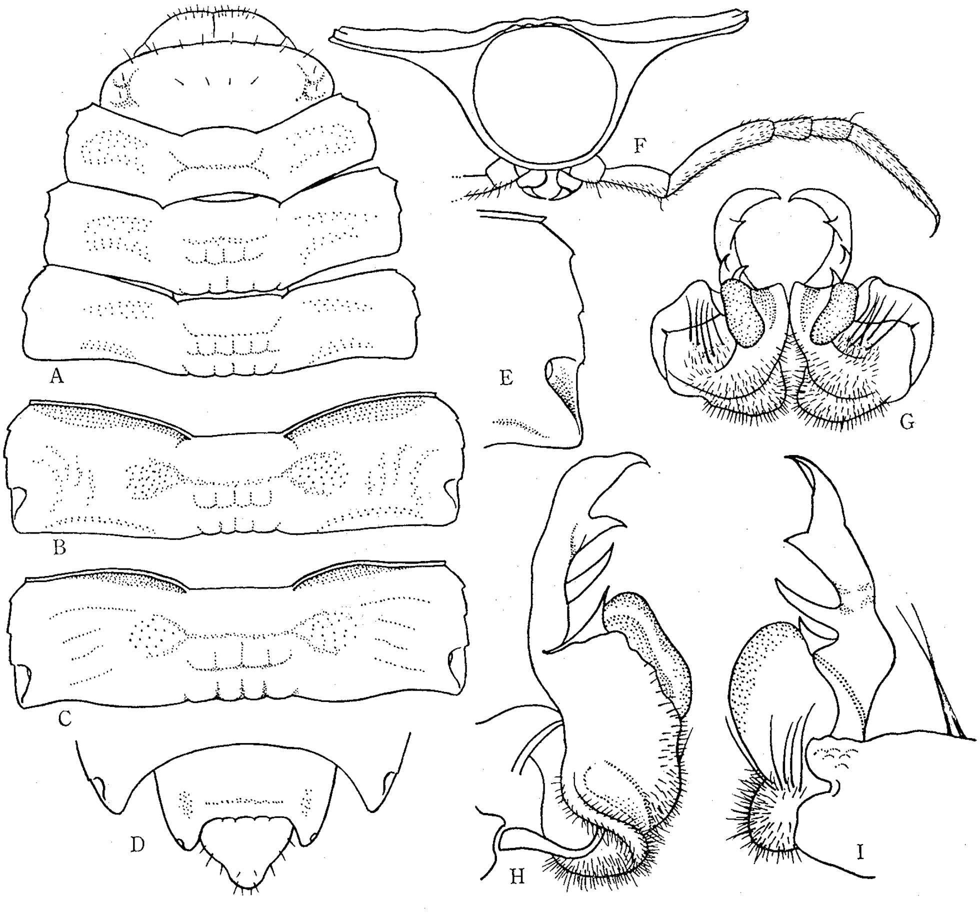

Fig. 2. *Epanerchodus kiuchii* n. sp., holotype. A, Head and four succeeding segments, dorsal aspect. B, Segment 7, the same. C, Segment 10, the same. D, Caudal end of body, the same. E, Right lateral margin of segment 7. F, Caudal aspect of segment 7, with a right leg. G, Gonopods, *in situ*, ventral view. H, Left gonopod, mesial aspect. I, The same, lateral aspect.

roundly produced, and with rough surface. Seminal canal opens to the innermost cavity. Tibiotarsus relatively broad, laminate, acute distally, and with a short process and long branch. Postfemoral process small and simple.

Female paratypes: Length 20–22 mm, width about 3.5 mm. Other somatic characters as in the male.

Material examined: 2 ♂♂ (including holotype), 4 ♀♀, 5 larvae, 2–3 April 1967, Himisé-dô Cave at Nagayasu, Kaminaka-chô, Tokushima Prefecture. S. Uéno collector. Holotype and 1 ♀ paratype are deposited in the National Science Museum, Tokyo. Remaining specimens of the type-series are retained in the author's collection.

Additional specimens from the type cave: 1 ♂, 2 larvae, 2 August 1965; 1 ♂, 1 ♀, 29 July 1966; 1 ♂, 1 ♀, 2 larvae, 30 April 1967; 2 ♀♀, 1 larva, 23 July 1967, coll. by M. Kiuchi and M. Yoshida; 2 ♂♂, 2 ♀♀, 10 December 1967, coll. by the author; 9 ♀♀, 2 larvae, 2 May 1968; 3 ♀♀, 3 larvae, 14 July 1968, coll. by S. Uéno.

Specimens from another cave: 1 ♂, 1 larva, 2 August 1965, Ôto-dô Cave at Ôto, Kaminaka-chô, Tokushima Prefecture, coll. by M. Kiuchi and M. Yoshida.

Notes: The present new species may easily be distinguished from *E. sulcatus* by the details of the male gonopods, especially by the shape of the tibiotarsus, which is broader, simpler and has no process on the outside, by the different shape of tibiotarsal and postfemoral processes, by the more slender legs, and by the absence of conical protuberances on sternites of segments 5 and 6.

This milliped was not abundant in the cave, as the type locality being found in the Y-shaped branch just above the entrance room as well as in a side passage at the depth.

Epanerchodus sulcatus, apparently a relative of this new species, was originally described from the limesone cave called Ja-ana, which lies to the northwest of Lake Hamana-ko. The present author is deeply indebted to Mr. Tsuneharu Okamoto for his kindness in obtaining a series of topotypical specimens of the Ja-ana species, which were used for comparison in the present study.

Epanerchodus biaduncus n. sp.

(Japanese name: Zenjô Obiyasude)

Diagnosis: A small troglobiontic species near *E. takashimai* Haga (1956, p. 377, pl. II, 30 a–b) in the form of body segments and the shape of gonopods, but distinguished from the latter by the details of the male gonopods.

Male holotype: Color greyish white. Length about 16 mm, greatest width 1.6 mm. Body small, slender; dorsum conspicuously impressed, with narrow lateral keels. The shape of head and of some selected segments as shown in text-figures; the widths of them as follows:

Head = 1.5 mm Collum = 1.2 mm Seg. 2 = 1.2 mm
Seg. 3 = 1.1 mm Seg. 4 = 1.1 mm Seg. 5 = 1.3 mm
Seg. 7 = 1.5 mm Seg. 10 = 1.5 mm Seg. 14 = 1.6 mm
Seg. 15 = 1.6 mm Seg. 18 = 1.4 mm.

Head large and densely covered with short or minute hairs. Antennae slender, approximately 3.5 mm long, and reaching back to the anterior border of segment 4; the ratio in length of joints 5 through 7 and in their width (in parentheses) is 19(6): 16(8):9(6); sensory groups on each of them usually well developed. Collum elliptical, narrower than head; posterior corners slightly angular; each side with a small notch; three rows of bristles and very weak sculpture present on the surface. Segments 2, 3 and 4 narrower than most of the succeeding ones; dorsum moderately convex and with tubercular impression of the usual general pattern on the surface; lateral keels narrow, rising obliquely upward, with the posterior corners well produced from segment 2. Dorsum of each succeeding segment with conspicuous impression bearing very fine bristles; typical form of body segment as shown in text-figure 3, B. Lateral keels narrow, moderately reflexed; posterior corners well produced, the teeth of segment 19 small and short; outer margin with 3–4 small, conspicuous notches;

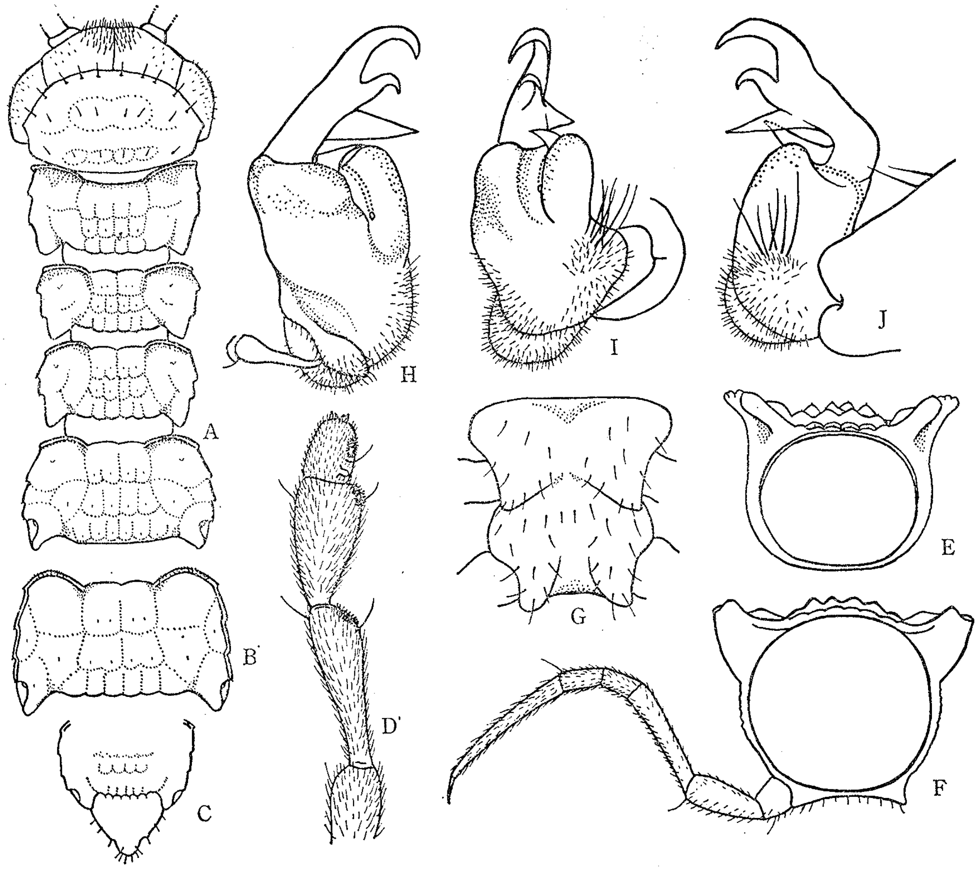

Fig. 3. *Epanerchodus biaduncus* n. sp., holotype. A, Head and five succeeding segments, dorsal aspect. B, Segment 10, the same. C, Caudal end of body, the same. D, Last three joints of antennae. E, Caudal aspect of segment 2. F, Same of segment 10, with a left leg. G, Ventral aspect of segment 18, to show the produced posterior corners. H, Left gonopod, mesial aspect. I, The same, ventral aspect. J, The same, lateral aspect.

each of the anterior and posterior margins of segments 10 through 18 provided with a strigilis. Pores small, open on the depressed lateral margin just behind the fourth notch of pore-bearing keels. Legs slender, without spherical bristles. Sternites quadrate and pubescent; crossing furrow rather shallow; posterior corners slightly produced on segments 8 through 18.

Gonopods as shown in text-figure 3, H–J. Coxa large; femur swollen, with several long bristles on the outer base; shaft of telopodite projecting ventrad, broad basally, curved and acute distally, and with a hook-like process and a large triangular branch on the inner side; postfemoral process small and acute.

Female paratype: Length 18–20 mm, width about 1.9 mm (in segment 10). Other somatic characters as in the male.

Type-series: 1 ♀, 23 November 1961; 1 ♂ (holotype), 5 ♀♀, 10 larvae, 10 June 1967; 1 ♂, 1 larva, 16 July 1967, Zenjô-kutsu Cave at Masaki, Kamikatsu-chô, Tokushima Prefecture. All these specimens were collected by M. Kiuchi and M. Yoshida. The holotype will be deposited in the National Science Museum, Tokyo, and paratypes are preserved in the author's collection.

Additional specimens from the same cave: 3 ♀♀, 4 larvae, 3 May 1968, coll. by S. Uéno.

Notes: As was pointed out in the diagnosis, this new species resembles *E. takashimai* Haga in both the somatic and genital characters. However, this may not be an indication of true relationship. *E. takashimai* has been known so far only from a lava cave at the southeastern foot of Mt. Fuji, which is about 400 km distant to the east from Zenjô-kutsu Cave. Moreover, there are various kinds of barriers between the two localities. The caves distributed in the intermediate area are known to harbour some troglobiontic *Epanerchodus*, which have no direct relationship either with *E. biaduncus* or with *E. takashimai*. It is, therefore, most probable that the superficial resemblance between the two species may have resulted from convergence.

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